

## REMARKS

The rejections under 35 U.S.C. § 103(a) of:

Claims 29-32 and 46-51 as unpatentable over JP 03-0430807 (JP '807) or U.S. 5,710,211 (Sato et al), each in view of *Organic Chemistry*, pages 682-83 (Morrison et al) or U.S. 5,352,750 (Yanai et al),

Claims 29-32 and 47-51 as unpatentable over U.S. 3,080,350 (Imai et al) in view of Morrison et al and Yanai et al, optionally in view of Examiner's Notice,

Claims 41-42 as unpatentable over the above combination of references, and further in view of the Kirk-Othmer excerpt on evaporation (Standiford), U.S. 5,418,269 (Ishiwa et al), and U.S. 3,684,768 (King et al),

are respectfully traversed.

The present invention concerns a polyvinyl alcohol polymer production method and a polyvinyl alcohol polymer (PVA). To be more specific, this invention concerns, along with PVA, a method of producing PVA polymer by saponifying a polyvinyl ester in an alcohol-containing organic solvent under the presence of a saponification catalyst and with which the saponification reaction is carried out while distilling off the carboxylic acid ester that is produced by the saponification reaction.

As described in the specification under "Description of the Prior Art," beginning at page 1, second paragraph, it is generally believed that in order to raise the degree of saponification of PVA in cases where alcohol is used to saponify a corresponding polyvinyl ester, the mole ratio of methanol with respect to PVA must be made high. However, too high a mole ratio causes other problems, such as PVA gelling, which then requires a large amount of organic solvents, such as dimethyl sulfoxide (DMSO) to prevent gelling, resulting in a concentration of PVA obtained of only a few percent at maximum. Thus, one of the objects

of the present invention is a method of producing PVA polymer having a generally higher degree of saponification than that of the prior art, that is obtained at a relatively low mole ratio of alcohol.

For attaining the above object, as described at page 9, lines 3-21 of the specification, and as recited in Claim 29, it is preferable to carry out the saponification reaction continuously comprised of a primary reaction, in which a polyvinyl ester is mixed in an alcohol-containing organic solvent under the presence of a saponification catalyst to carry out the saponification reaction, and a secondary reaction, in which the saponification reaction is carried out while distilling off the carboxylic acid ester that is produced.

The degree of saponification of PVA can then be increased and the reaction can be controlled by adjusting the mole ratio of alcohol with respect to PVA and the degree of saponification in the secondary saponification can be controlled by adjusting the rate at which the alcohol and carboxylic acid ester are distilled off.

According to the present invention, the secondary saponification is carried out in a heat-exchanging type reactor selected from the group consisting of: a platefin type evaporator, a falling film evaporator, and a shell and tube type evaporator while distilling off the carboxylic ester that is produced.

All the but the above-stated rejection of Claims 41-42 are now moot, in view of the above-discussed amendment.

None of JP' 807, Sato et al, Morrison et al, Yanai et al or Imai et al disclose the saponification reaction to be comprised of a primary and secondary saponification reaction as recited in the present claims, much less a secondary saponification reaction, in which saponification is carried out in a heat-exchanging type reactor selected from the group

consisting of: a platefin type evaporator, a falling film evaporator, and a shell and tube type evaporator while distilling off the carboxylic ester that is produced.

None of the above-applied prior art even addresses the above-discussed problem of the prior art degree of obtaining a relatively high degree of saponification of PVA by using a relatively low mole ratio of alcohol with respect to PVA.

Indeed, such a low mole ratio of alcohol could not possibly be arrived without first coming up with the saponification comprised of the primary and secondary saponification reactions. Note the Examiner's statement at paragraph 11 of the Office Action, referring to Morrison et al and Yanai et al, that in order to shift the equilibrium to the right, it is necessary so far to use a large excess of the alcohol to get PVA polymer which has a higher degree of saponification. Indeed, Morrison et al and Yanai et al actually teach against the present invention. Note the argument above with regard to the disadvantages of too high a mole ratio of alcohol, such as PVA gelling and the consequent need for a large amount of organic solvent.

The Examiner states that "[Sato et al] exemplifies hydrolysis reactions in the examples wherein the concentration of the functionalized vinyl acetate polymer is above 10 wt% PVOH. As the hydrolysis reaction has been equated to the ordinary hydrolysis of PVAc, it would have been obvious to one of ordinary skill in the art that such concentration are known to be used in the hydrolysis reactions disclosed for PVAc."

However, the concentration is **not** for PVA but a modified PVA in Sato et al. Sato et al neither discloses nor suggests solving the problem to increase the degree of saponification, and/or to reduce the amount of alcohol required to achieve high degrees of saponification.

In Example 1 in Sato et al, for example, the degree of saponification is 97.0 mol %. But, if the amount of alcohol were reduced, the degree of saponification would become low.

The Examiner states the shell and tube evaporators are the most widely used type of film evaporator used, among which one version is the falling film type, and in the field of polymer technology it is well known to employ film type evaporators. However, it has been not known to use such a shell and tube evaporator in a saponification reaction, much less to reduce the amount of alcohol required to achieve high degrees of saponification. Indeed, without the present disclosure as a guide, one skilled in the art would not have used a heat-exchanging reactor as recited herein.

For all the above reasons, it is respectfully requested that the rejections over prior art be withdrawn.

The rejection of Claims 41 and 46 under 35 U.S.C. § 112, second paragraph, is respectfully traversed. Indeed, the rejection is now moot in view of the above-discussed amendment. Accordingly, it is respectfully requested that it be withdrawn.

All of the presently-pending and active claims in this application are now believed to

be in immediate condition for allowance. Accordingly, the Examiner is respectfully requested to pass this application to issue.

Respectfully submitted,

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<b>Marked-Up Copy</b> Serial No: _____ Amendment Filed on: _____
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IN THE CLAIMS

Please amend the claims as follows:

--29. (Amended) A method of producing polyvinyl alcohol polymer comprising:  
saponification of a polyvinyl ester in an alcohol-containing organic solvent under the presence of a saponification catalyst, wherein saponification is carried out with a mole ratio of alcohol with respect to polyvinyl alcohol of 1.0 to 3.0, wherein saponification comprises: a primary saponification reaction, in which saponification is carried out by mixing the polyvinyl ester in an alcohol containing organic solvent under the presence of a saponification catalyst, and subsequent secondary saponification reaction, in which saponification is carried out in a heat-exchanging reactor selected from the group consisting of: a platefin evaporator, a falling film evaporator, and a shell and tube evaporator while distilling off the carboxylic ester that is produced [by the saponification reaction].

30. (Cancelled)

31. (Amended) The method of Claim [30] 29, wherein the degree of saponification attained in said primary saponification reaction is 70 mole% or more and the concentration of the polyvinyl alcohol polymer in the saponification reaction solution is 10 wt% or more.

32. (Amended) The method of Claim [30] 29, wherein the degree of saponification attained in said secondary saponification reaction is 85 mole% or more and the concentration of the polyvinyl alcohol polymer in the saponification reaction solution is 10 wt% or more.

33. (Amended) [The method of Claim 30] A method of producing polyvinyl alcohol polymer comprising:

saponification of a polyvinyl ester in an alcohol-containing organic solvent under the presence of a saponification catalyst, wherein saponification is carried out while distilling off the carboxylic ester produced by the saponification reaction, wherein saponification comprises:

a primary saponification reaction, in which saponification is carried out by mixing the polyvinyl ester in an alcohol containing organic solvent under the presence of a saponification catalyst, and

a subsequent secondary saponification reaction, in which saponification is carried out while distilling off the carboxylic ester that is produced, wherein said saponification reaction comprises:

a first stage saponification process, comprised in turn of a primary saponification reaction, in which a saponification reaction is carried out by mixing the polyvinyl ester in the alcohol-containing organic solvent under the presence of a saponification catalyst and

a subsequent secondary saponification reaction, in which a saponification reaction is carried out while distilling off the carboxylic ester that is produced; and

a subsequent second stage saponification process, comprised in turn of a primary saponification reaction, in which a saponification reaction is carried out by mixing the polyvinyl ester in the alcohol-containing organic solvent under the presence of a saponification catalyst and

a subsequent secondary saponification reaction, in which a saponification reaction is carried out while distilling off the carboxylic ester that is produced.

41. (Cancelled)

42. (Cancelled)

43. (Amended) The method of Claim [30] 33, wherein said primary saponification reaction is carried out in substantially a complete mixing type reactor.

44. (Amended) The method of Claim [30] 33, wherein said reactor is a kneader type mixer.

46. (Cancelled)

48. (Amended) The method of Claim 29, wherein said alcohol-containing organic solvent comprises at least one [type of] solvent selected from the group consisting of dimethyl sulfoxide, dimethylformamide, dimethylacetamide, N-methylpyrrolidone, ethylenediamine, and diethylenetriamine.

51. (Cancelled).--